

EPA recognizes that pollution prevention, rather than remediation, is the preferred solution to environmental problems. EPA's approach to pollution prevention includes fostering innovative design and production techniques to minimize or eliminate industrial waste, creating fundamental changes in the production and delivery systems that move goods and services to the American consumer, and developing sustainable approaches for using our natural resources.

NONPOLLUTING METAL SURFACE FINISHING

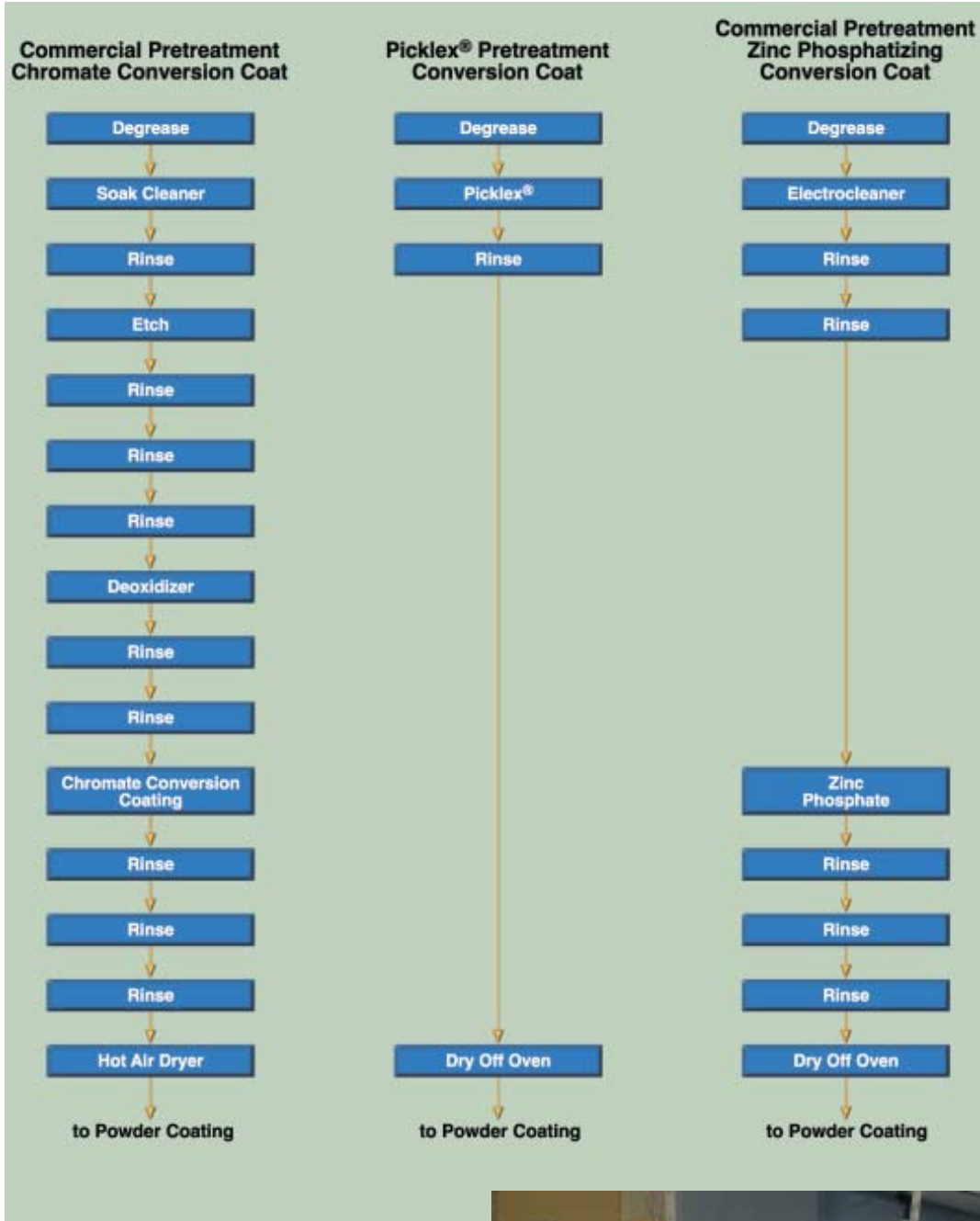
Metal surface finishing is a major industry that uses large quantities of hazardous chemicals and produces significant amounts of hazardous waste. Developing a metal surface finishing process that reduces the amount of chemicals used and the amount of waste generated, while maintaining product output, would benefit the metal finishing industry and the environment.

Pollution Prevention and New Technologies

At ORD, pollution prevention and new technologies research is targeted at the sources that pose the greatest risks to human health and the environment. This research informs regulatory officials, industry, and consumers about pollution prevention opportunities and presents verified, commercial-ready technologies and methods for use in both the public and private sectors.

ORD encourages the development of promising pollution prevention techniques and other technologies.

Under laboratory and field conditions, ORD scientists conducted an assessment of Picklex[®], a nontoxic proprietary product, as an alternative to conventional metal surface pretreatments. The results of both laboratory tests and a field demonstration showed that Picklex[®] can provide effective and efficient metal surface preparation for many metal finishing operations. The Picklex[®] process requires fewer steps, avoids the use of some hazardous chemicals, and generates no hazardous waste. Also, using Picklex[®] eliminates numerous rinsing steps, which means less floor space is needed for rinse tanks. Other advantages of the Picklex[®] process include easy agitation of the solution, slow evaporation rate, and operation at ambient temperatures.



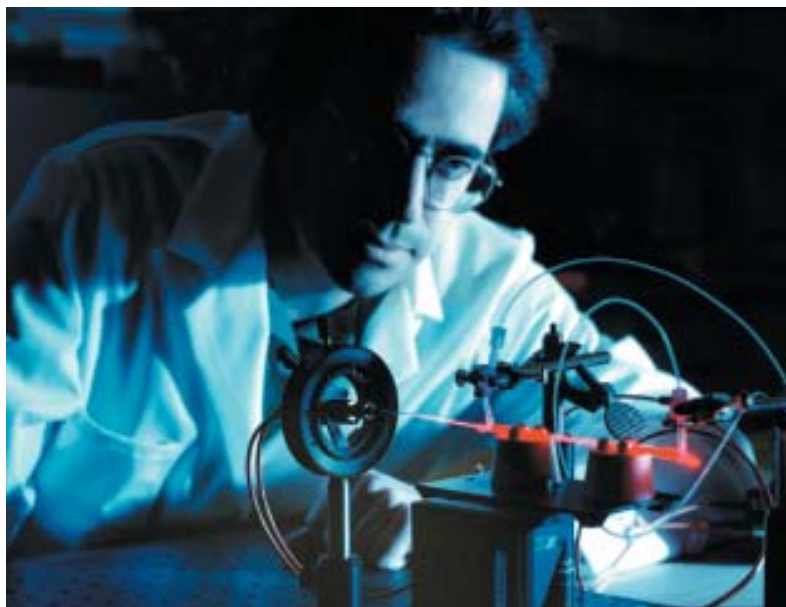
Comparison of the steps required for two conventional pretreatment processes with Picklex® pretreatment.



Worker spraying powder coat on test panels.

LOW-POLLUTION POLYMER SYNTHESIS

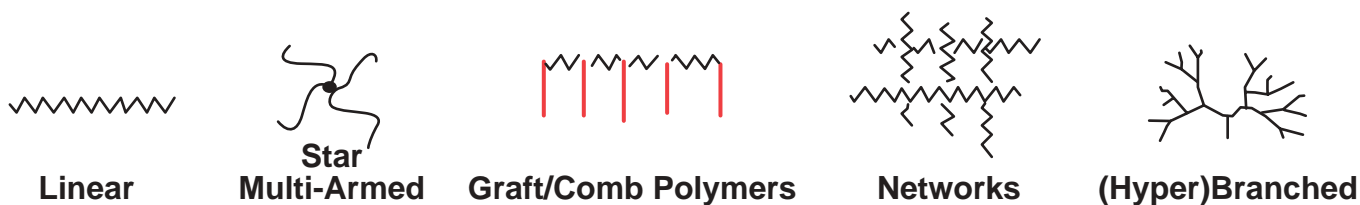
Polymers, complex molecules made up of repeating subunits, are used in plastics, advanced microelectronics, optics, ceramics, and many other useful products. Historically, high-performance polymers have been produced using methods requiring hazardous organic solvents under very carefully controlled reaction conditions. A new procedure, called atom transfer radical polymerization (ATRP), is being developed by EPA grant recipients at Carnegie Mellon University. ATRP is a simple, inexpensive, and innovative technology that produces polymers with a variety of specific features. The process either uses minimal amounts of hazardous solvents or completely replaces them with safer, more environmentally friendly solvents. ATRP has attracted intense interest from industry; four corporate licenses have been signed, granting permission to use ATRP commercially, and two industrial consortia have formed to define the scope and explore the limitations of ATRP and similar technologies.



ORD scientist demonstrating a biosensor method to measure environmental pollutants.

WASTE-REDUCING TECHNOLOGY FOR GROUNDWATER

Volatile chlorinated solvents have been used widely as industrial degreasing, cleaning, and dry cleaning agents for decades. In the past, disposing of these solvents involved pouring them on the ground and allowing them to evaporate. However, much of the solvent infiltrated the soil rather than evaporating as expected. Over time, heavy chlorinated solvents seep into groundwater, forming pools that persist



A polymer's composition and architecture, such as the forms shown here, determine its physical and mechanical properties.



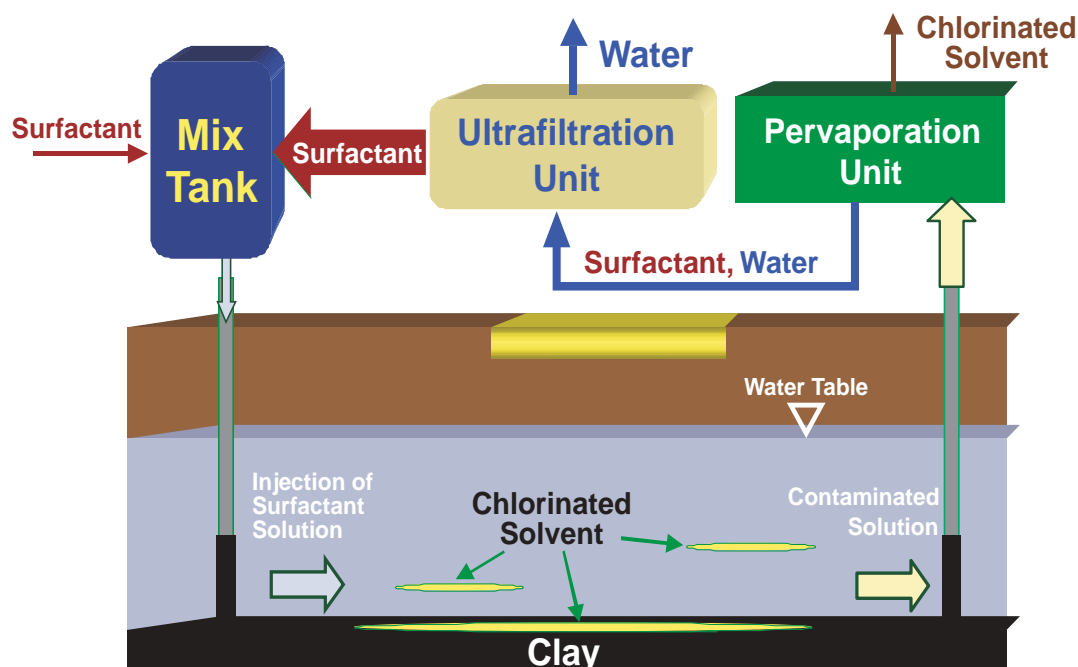
Scientists working at the pervaporation field demonstration site.

for many years and that serve as ongoing sources of contamination. Many of these chlorinated solvents are either known or suspected to cause cancer.

ORD scientists participated in a successful field demonstration of a new technology called pervaporation, a process enabling the recovery and recycling of a water-based remediation fluid used to remove chlorinated solvents from contaminated soil. The pervaporation technology removed volatile contaminants from the remediation fluid and ultrafiltration technology concentrated the surfactant, which was added to facilitate extraction of the solvent from soil. This procedure

allows up to 95 percent of surfactant in the fluid to be recovered and reused, reducing surfactant costs by approximately 80 percent. In addition, because the surfactant is reused and not discarded with the contaminants, disposal costs are greatly reduced.

Schematic diagram of the integrated below-ground extraction and above-ground surfactant recovery-and-recycling processes.



ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

On October 1, 2000, EPA's Environmental Technology Verification (ETV) Program began operation as a full-scale program following a five-year pilot period. The Program was created to verify the performance of innovative technologies developed to prevent or solve environmental problems. ORD manages this Program, which operates through public-private testing partnerships to evaluate the performance of commercial-ready environmental technologies. By providing independent and credible information about the verified technologies, the Program accelerates the entrance of new environmental technologies into both domestic and international marketplaces. Technology purchasers and government officials who authorize use of technologies at specific remediation sites report that information provided by the ETV Program helps them decide which technology is appropriate for each situation.

A major accomplishment of the ETV Program is development of uniform tests and protocols to evaluate new technologies. To date, the Program has produced over 90 test plans and 60 generic protocols—all of which are peer reviewed and available to the public on the Program's web site. These test procedures are now used far beyond the borders of the United States. For example, India and Bangladesh are using the Program's protocols to identify technologies capable of addressing their very



In 2001, ORD purchased two new electric cars for use by security officers and facility maintenance personnel at the Research Triangle Park location.

serious problems with arsenic in drinking water. An international consortium lead by Japan is evaluating an ETV Program protocol for testing baghouse filtration products for potential use as an international standard. The recently issued New Zealand drinking water standards refer to Program protocols for microfiltration technologies.

Technologies evaluated by the ETV Program include those for

- reducing nitrogen oxide emissions by using alternative fuels;
- real-time monitoring of pollutants in air, water, and soil;
- preventing leaks of greenhouse gases from natural gas pipelines;
- controlling Cryptosporidium and arsenic in small community drinking water systems; and
- reducing volatile organic compound (VOC) emissions from surface-coating operations.



Assessing water quality near a Superfund site.

In 2001, the ETV Program completed 82 technology tests and reports, bringing the cumulative total to 164 verifications since 1995. The technologies span a broad range of categories including environmental monitoring, air pollution control, drinking water protection/treatment, greenhouse gas control, water protection, and pollution prevention. Also in 2001, EPA signed Memoranda of Agreement with the U.S. Department of Defense, the U.S. Coast Guard, and the Commonwealth of Massachusetts to conduct joint verifications. In keeping with its objective to widely distribute information about new technologies, ETV Program representatives presented information at over 60 national and international conferences. In its short life, this Program has

become the most comprehensive environmental technology verification program in the world.

SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION (SITE) PROGRAM

In response to the Superfund Amendments and Reauthorization Act, EPA's Superfund Innovative Technology Evaluation (SITE) Program was established by the Office of Solid Waste and Emergency Response and ORD. Administered by ORD, the SITE Program offers a mechanism for conducting joint demonstrations and evaluations of innovative technologies at Superfund sites. ORD invites partners from across EPA, other federal and state agencies, and the public sector to participate in these projects. The SITE Program is not a pollution prevention activity *per se*; rather, its primary purpose is the expedited cleanup of the Nation's most contaminated sites.

Example SITE Program Demonstrations in 2001 include

- thermal treatment of PCB-contaminated sediment,
- chemical stabilization of mercury mining waste,
- *in situ* steam treatment of chlorinated solvents in fractured bedrock, and
- electrokinetic technology to mobilize and extract lead compounds from soil.

The SITE Program encourages the development and implementation of innovative technologies for hazardous waste cleanup and for monitoring and measurement.

Since the SITE Program began in 1986, cleanup of contaminated sites using innovative technologies has resulted in a total cost savings of over 2.4 billion dollars. The SITE Program is recognized as a leader in advancing innovative technology development and commercialization. In 2001, 146 remediation technology vendors participated in the program. Also in 2001, the Environmental Council of States (ECOS) acknowledged the SITE Program for its efforts in demonstrating innovative technologies and their associated cost savings. ECOS champions the efforts of its fifty-two member states and territories in achieving better environmental protection through the use of innovative technologies.

LOOKING TO THE FUTURE

Milestones that will be reached in the near future include

- *ten new stakeholder-approved, peer-reviewed protocols for testing new technologies under the Environmental Technology Verification Program,*
- *an international conference on clean production technologies hosted by ORD,*
- *a state-of-the-science report on bioengineering for pollution prevention, and*
- *new methods for evaluating conventional agricultural production and agricultural biotechnology from an environmental management perspective.*



